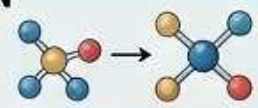
# UNIT 1: CHEMICAL REACTIONS

## LESSON 1: CHEMICAL REACTIONS

### CONCEPT OF CHEMICAL REACTION

Breaking of existing chemical bonds within reactant molecules and forming new bonds within product molecules.



### 1. THERMAL DECOMPOSITION REACTIONS

| Compound Type | General Rule (Heated) | Example (Equation) | Evolved Gas & Detection |
|---|---|---|---|
| Metal Oxides | Metal Oxide | $2HgO \rightarrow 2Hg + O_2$ (Oxygen) | + Oxygen |
| Metal Hydroxides | Metal Oxide + Water Vapor | $Cu(OH)_2 \rightarrow CuO + H_2O$ Copper(II) Oxide | + $H_2O$ Water Vapor |
| Metal Carbonates | Metal Oxide + $CO_2$ (Carbon Dioxide) | $CuCO_3 \rightarrow CuO + CO_2$ | + Gasses |
| Metal Sulfates | Metal Oxide + $SO_3$ (Sulfur Trioxide) | $CuSO_4 \rightarrow CuO + SO_3$ | + Gasses |
| Metal Nitrates | Metal Nitrite + $O_2$ (Oxygen) | $2NaNO_3 \rightarrow 2NaNO_2 + O_2$ | + Oxygen |

### 3. OXIDATION & REDUCTION REACTIONS

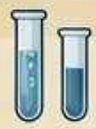
Side it cunilt got oftonse eridlaction prhates.

| Comparison Point | Traditional Concept (Oxygen/Hydrogen) | Modern (Electronic) Concept |
|---|---|---|
| Oxidation | Increase in O / Decrease in H | → − |
| Reduction | Decrease in O / Increase in H | → + |
| Oxidizing Agent | Donates O / Removes H | → − |
| Reducing Agent | Removes O / Donates H | → − |

## 2. DISPLACEMENT REACTIONS

The activity series concept to the activity series:

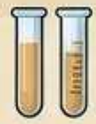
### (A) Single Displacement



**Metal replacing Hydrogen of Water**

$2Na + 2H_2O \rightarrow 2NaOH + H_2$

Metal + Water -> Metal Hydroxide + Hydrogen gas (evolved)



**Metal replacing Hydrogen of Acid**

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

- Metal + Acid -> Metal Salt + Hydrogsing, within C2 ro ar s delly change.

**Metal replacing another metal in a salt solution**

$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$

More active Metal + Less active Metal Salt

- Cu not reacting with HCl. If Al reaction reacting with HCl.

### (B) Double Displacement

**Acid + Base (Neutralization)**

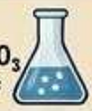
$NaOH + HCl \rightarrow NaCl + H_2O$

Hydrochloric Acid — Sodium Hydroxide Solution

**Acid + Salt**

$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$

Sodium Carbonate Solution — Dilute Hydrochloric Acid



**Salt + Salt**

$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl$

Sodium Chloride Solution — Silver Nitrate Solution

**LIFE APPLICATION: THE AIRBAG**

$2NaN_3 \rightarrow 2Na + 3N_2$

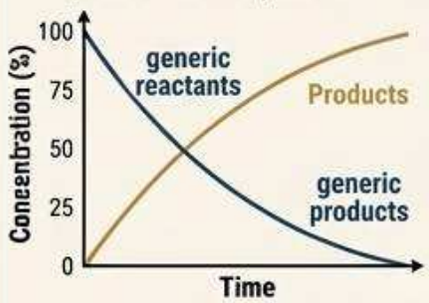
(Nitrogen Gas fills the bag)

**LIFE APPLICATION: THE AIRBAG**

A special chemical reaction inside the airbag, triggered by an electric spark from a sensor on impact, rapidly produces nitrogen gas. This gas fills the bag almost instantly, providing a protective cushion for the passenger.

## LESSON 2: SPEED OF CHEMICAL REACTION

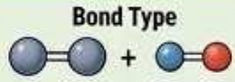
The speed of a chemical reaction is defined by how fast reactants are consumed and products are formed per unit time.



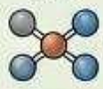

The graph illustrates a rapid initial consumption of reactants and formation of products, with rates **decreasing** as reactants are depleted.

**1 NATURE OF REACTANTS**

Bond Type



Ionic — Covalent



Surfan area = small vs large pieces

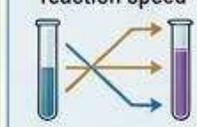
Surface Area in nealied

Small — Large pieces

Explanatic meaals of reaction speed.

**2 CONCENTRATION OF REACTANTS**

Reaction speed on reaction speed



$2H_2O \rightarrow 2H_2O + O_2$

equation

**3 TEMPERATURE**

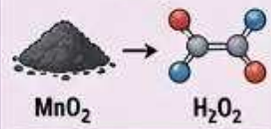
Effect on reaction reaction speed

Boiling on reaction reaction speed.

**Note:** Boiling food in evari site is used and boiling food.

**4 CATALYSTS & ENZYMES**

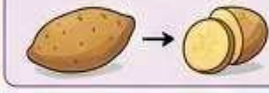
Catalyst/Negative Catalyst $MnO_2$




**Enzyme**

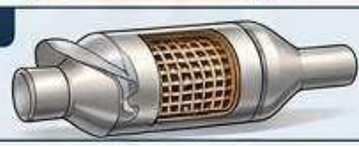
**Oxidase in sweet potato**

(Example, sarmet sweet potato slice)



**LIFE APPLICATION: THE CATALYTIC CONVERTER**

Treats harmful engine exhaust gases to conversal encxust gases in, ceramic, consus nonn-nararts and uses ceramic and rare metals.

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# Unit Two: Electrical Energy and Radioactivity

## Lesson One: Physical Properties of Electric Current

**Electric Current:** The flow of electric charges (free electrons) through metallic conductors in closed circuits.

### Three Main Properties of Electric Current

| Measuring Device & Connection Method | Measuring Unit & Equivalent | Mathematical Law | Concept | Property |
|---|---|---|---|---|
| Current Intensity (unt) | $I = \frac{Q}{t}$ | Ampere (Coulomb/Second) | The quantity of charge that passes through a conductor cross-section per second. | Ammeter (A) Connected in Series |
| Potential Difference (V) | $V = \frac{W}{Q}$ | Volt (Joule/Coulomb) | The work done to move a unit charge between two points in a conductor. | Voltmeter (V) Connected in Parallel |
| Electric Resistance (Ω) | $R = \frac{V}{I}$ | Ohm (Volt/Ampere) | The opposition that a substance offers to the flow of electric current. | Ohmmeter (Ω) to measure resistance value |

### Variable Resistance (Sliding Rheostat)

Principle: Controiling the resistance value by changing the length of the wire integrated in the clrcuit.
Importance: Controlling current intensity in the circuit, thus controlling potential difference between different parts.

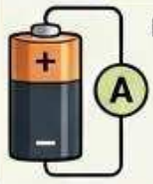
(Wire Length Increases → Resistance Increases → Current Intensily Decreases)

### Ohm's Law

Current intensity is directiy proportional to potential difference across terminals at constant temperature.

$V = R \times I$

### Electromotive Force (EMF)




Potential difference between source terminals when circuit is open (no current flows). Measured in Volts using a Voltmeter.

## Lesson Two: Electric Current and Cells

### COMPARISON OF CURRENT TYPES

| Alternating Current (AC) | Direct Current (DC) | Basis for Comparison |
|---|---|---|
| From generators (alternators) | From electrochemical cells (batteries) | |
| Transmission over long distances with minimal loss | Suitable for low-voltage, portable power | Sobit storing |
| High-voltage transmission lines | Not efficient over long distances | Helit dgically |
| Homes, factories, and main grid usage | Portable electronic devices, electronics | Comparison |

### SERIES CONNECTION (BATTERIES)

| Series Connection | | Parallel Connection | Battery EMF |
|---|---|---|---|
| Total Voltage = Sum of all cell voltages | | Total Voltage = One cell voltage | Purpose |
| Total EMF = ∑ EMF (e.g., $V_{total} = e_1 + e_2 + ...$) | | Total EMF = $E_1$ ($V_{total} = e_1$) | Connection Method |
| Example (3 cells of 1.5V): $V_{total} = 1.5 + 1.5 + 1.5 = 4.5V$ | | Example (3 cells of 1.5V): $V_{total} = 1.5V$ | Comparison Basis |
| Highest EMF | Lowest EMF | To obtain the lowest electromotive force. | Comparison Basis |

## Lesson Three: Radioactivity and Nuclear Energy

### Nuclear Binding Forces

Forces to bind nucleus nucleus components, overcoming repulsion between positive protons. (Energy store)

### Phenomenon of Radioactivity

M discovered uranium

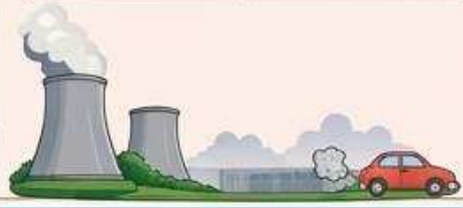
Elements definition note with beta, element names and aadium, gamma, storp, radium, names, samnn, nanma, and beta, protc etc.

Radium alpha beta gamma

**Scientific Genius**
(Discoverer: Scientist Henri Becquerel)

### (Radioactive Pollution)

| effects & damages | dose / period |
|---|---|
| CNS | Severe central nervous system damage, brain function decline |
| Physical | Leukemia (cancer), skin burns, organ dysfunction |
| Cellular | Genetic mutations, cellular disruption, metabolic failure |



### Peaceful Uses of Nuclear Energy

| | |
|---|---|
| Medicine | Medical diagnostics and cancer treatments |
| Agriculture | Improving crop yields and pest control |
| Industry | Quality control and material processing |
| Electricity Generation | Nuclear power production |
| Space | Deep space exploration and propulsion |

**Unit Two Summary** Completed successfully. Summarized for Student Success.

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# UNIT 3: GENES AND HEREDITY

## Learning About: BASIC PRINCIPLES OF HEREDITY

**HEREDITY:** The science that explains similarities and differences in hereditary characteristics among parents and offspring, and how they are transmitted from one generation to the next.

## SECTION 1: TYPES OF HUMAN TRAITS

| TRAIT TYPE | CONCEPT | EXAMPLES |
|---|---|---|
| Hereditary Traits | transferable from generation to generation | hair: hair color, skin color, blood type, finger count |
| Acquired Traits | not transferable, but learned from the environment | soccer skills, language proficiency, typing, instrument playing, etc. (Concise examples) |

## SECTION 2: MENDEL'S EXPERIMENTS

1. Shorter life cycle.
2. Flowers are self-pollinating.
3. Easy to cross-pollinate.
4. Produces a large number of offspring in one generation.
5. Several contrasting traits that are easy to distinguish.

### Key Steps in Mendel's Experiments:

1. Emasculated flowers by removing stamens (anthers) to prevent self-pollination.
2. Covered flower heads to prevent foreign random cross-pollination by other pollen.

## DOMINANT AND RECESSIVE TRAITS IN PEA PLANTS (Principle of Complete Dominance)

The appearance of the dominant hereditary trait in the first generation offspring (100% dominant) when crossing two pure individuals with contrasting hereditary traits.

| CHARACTER | DOMINANT TRAIT | RECESSIVE TRAIT |
|---|---|---|
| 1 Flower Color | Red | White |
| 2 Seed Color | Yellow | Green |
| 3 Seed Shape | Smooth | Wrinkled |
| 4 Pod Color | Green | Yellow |
| 5 Stem Height | Tall | Short |

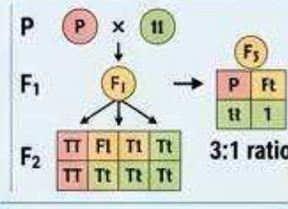
## MENDEL'S LAWS OF HEREDITY

### 1. MENDEL'S FIRST LAW: THE LAW OF SEGREGATION

**Applies to:** One pair of contrasting traits.

**Law Description:** When pure parents with contrasting traits are crossed, the first generation (F1) shows 100% of the dominant trait. In the second generation (F2), both traits appear in a ratio of 3 dominant : 1 recessive.

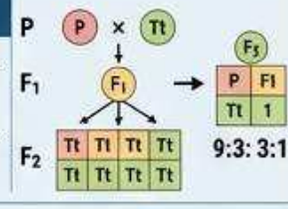
**Reason:** The alleles separate (segregate) during gamete formation and rejoin during fertilization.




### 2. MENDEL'S SECOND LAW: THE LAW OF INDEPENDENT ASSORTMENT

**Applies to:** Two or more pairs of contrasting traits.

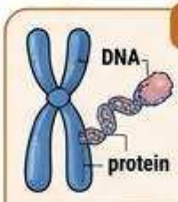
**Law Description:** When pure parents with two or more opposite traits are crossed, each trait is inherited independently of the others, and all traits appear in the second generation (F2) in a simple dihybrid ratio (9: 3 : 3: 1).




## TYPES OF INDIVIDUALS ACCORDING TO GENOTYPE

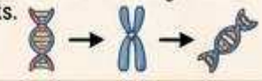
| INDIVIDUAL TYPE | DESCRIPTION |
|---|---|
| Pure Individual<br>TT or tt<br>TT tt | Carries two identical genes for a heritable trait - 'TT' dominant pure or 'tt' recessive pure; characteristic (TT) or characteristic (tt) appears. |
| Hybrid Individual<br>Tt<br>Tt | Carries two different genes – Tt'; only the dominant characteristic appears (Tt). |

## THE CHROMOSOMES AND GENES




**CHROMOSOMES:** Chemically composed of DNA (Deoxyribonucleic acid) wrapped around protein molecules.

**GENES:** Specific parts of the DNA molecule located on chromosomes, responsible for showing heritable traits.



How genes control characteristic discovery.

**WATSON & CRICK:** Proposed a double helix model for the DNA structure as a spiral strand twisting like a hellx.

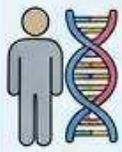
## SECTION 5: SCIENCE, TECHNOLOGY, AND SOCIETY (LIFE APPLICATIONS)

### 1. GENETICALLY MODIFIED RICE (GOLDEN RICE)

**PROBLEM:** Lack of Vitamin A in developing countries where rice is a staple food, leading to eye diseases and blindness.

**SOLUTION:** Use genetic engineering to insert a gene for beta-carotene (pro-vitamin A) into rice, enabling the body to synthesize Vitamin A.

### 2. THE HUMAN GENOME PROJECT



**Definition:** A complete map of all human genes on the chromosomes.

**Goals:** Determining the functions of all human genes; identifying target genes responsible for diseases (e.g., cancer, aging); determining target effects.

**Results:** Human DNA is over 99% identical. Individual differences (less than 1%) determine features such as facial features, height, and susceptibility to certain diseases.

>99% SIMILARITY

<1% DIFFERENCE

## ★ COMPLETED UNIT 3 SUMMARY ★

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# UNIT FOUR: HORMONAL REGULATION IN HUMANS

## Basic Concepts in the Formocepts

### Hormones
"messengers": chemical substances that regulate vital activities and functions in a living organism's body.

### Endocrine Glands (Ductless)
Ductless glands; they pour their secretions directly into the bloodstream.

### Target Cells
Specific cells affected by the hormone, usually located far from the gland that secretes it.

### Hormonal Imbalance
Increase or decrease of a hormone secretion, resulting from incorrect functioning of the gland.

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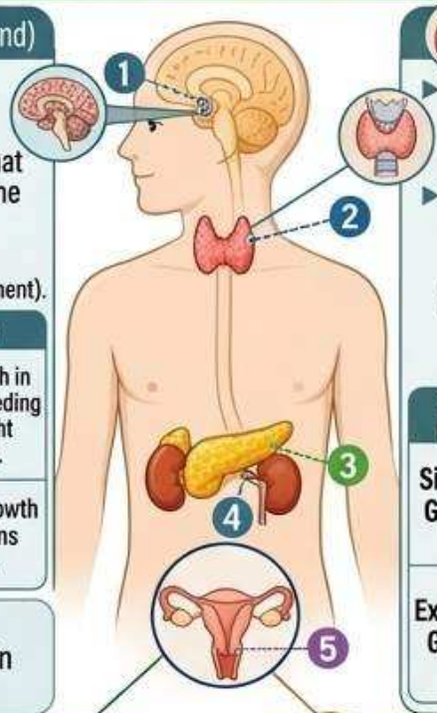


## PITUITARY GLAND (The Master Gland)

- **Location:** At the base of the brain, consisting of two lobes.
- **Why Master Gland?:** Secretes hormones that regulate and stimulate the work of most of the other endocrine glands.
- **Main Hormone: Growth Hormone (GH):**

Regulates general body growth (muscle & bone development).

| GH Imbalance | Reason | Symptoms |
|---|---|---|
| Gigantism | Over-secretion of GH in childhood. | Excessive growth in limb bones, exceeding standard height (two meters). |
| Dwarfism | Under-secretion of GH in childhood. | Stunted body growth (person remains very short). |

**Other Hormones**
TSH • ACTH • FSH • LH • ADH • Prolactin
Oxytocin

## THYROID GLAND

- **Location:** In the front part of the neck, below the larynx, consisting of two lobes on both sides of the trachea.
- **Secretions:**
  1. **Thyroxine (T4):** "Releases the necessary energy for the body from nutrients." (Iodine nete)
  2. **Calcitonin:** "Regulates calcium levels in the blood."

**Symptoms**

| Thyroxine Imbalance | Reason | Symptoms |
|---|---|---|
| Simple Goiter | Under-secretion of Thyroxine (due to lack of Iodine in diet). | Enlargement of the simple thyroid gland, swelling of the neck. |
| Exophthalmic Goiter | Over-secretion of Thyroxine in large amounts. | Severe enlargement of the thyroid gland, protrusion of the eyeballs, weight loss, rapid pulse. |

## PANCREAS GLAND (Dual-Function / Mixed)

- **Location:** Between the stomach and small intestine.
- **Why dual-function?:** Secretes two contrasting hormones (Insulin & Glucagon) to maintain the standard glucose level in the blood.
- **Normal Blood Glucose Levels:** (Healthy person: 80-120 mg/100 cm³).

| Hormone | When Secreted? | Function |
|---|---|---|
| Insulin ↓ | Upon high blood glucose level. | Lowers blood glucose levels; stimulates cells to consume glucose, stimulates liver to store excess as glycogen. |
| Glucagon ↑ | Upon low blood glucose level. | Raises blood glucose levels; stimulates liver to convert stored glycogen back into glucose. |

135 mg/dL

**Diabetes Mellitus (High Blood Sugar):** A disease resulting from under-secretion of Insulin, which leads to high blood sugar and its excretion in urine.

**Key symptoms:** Excessive thirst, frequent urination, weight loss.

## ADRENAL GLANDS (Emergency Glands)

- **Location:** On top of each kidney.
- **Secretion:** Adrenaline Hormone.
- **Function:** Stimulates body organs for quick responses in emergency situations (fear, anger, emotional stress, flight).

## REPRODUCTIVE GLANDS (Gonads)

| Gland | Secreted Hormone | Function |
|---|---|---|
| Testes (Male) | Testosterone | Appearance of secondary male sexual characteristics. |
| Ovaries (Female) | Estrogen & Progesterone | Appearance of secondary female sexual characteristics. |
| | Progesterone | Stimulates uterine lining growth (preparation for pregnancy). |

## Synthesis of Growth Hormone (Genetic Engineering)

### Science, Technology, and Society (Life Applications)

**Problem**
Stunted growth due to under-secretion of HGH

**Old Solution**
Extraction of HGH from human cadavers.
Extremely limited, potential for diseases

**New Solution**
1. Gene insertion → 2. Bacterial vector (E. coli) → 3. Large-scale production → 4. Highly pure synthesis.

Gene for human growth hormone is inserted into a bacterial cell (e.g., E. coli). Bacteria reproduce rapidly, producing highly pure human growth hormone.
Timeline note: Successful large-scale production since 1979,
All numbers preserved: 80-120 mg/100 cm², 135 mg/dL, 1979

**ACHIEVEMENT UNLOCKED! YOUR COMPLETE SCIENCE REVIEW GUIDE.**

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